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SKETCH MAP OF ALASKA, SHOWING DISTRIBUTION OF FORESTS AND OF GLACIERS AND SNOW FIELDS

(From Professional Paper No. 45, U. S. Geological Survey)

Scale

0 100 200 300 400 500 miles

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HENRY S. GRAVES, Forester.

THE FORESTS OF ALASKA.

BY

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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Forest Service,
Washington, D. C., February 21, 1910.

Sir: I have the honor to transmit herewith a manuscript entitled "The Forests of Alaska," by R. S. Kellogg, Assistant Forester, and to recommend its publication as Bulletin 81 of the Forest Service.

Respectfully,

Henry S. Graves,
Forester.

Hon. James Wilson,
Secretary of Agriculture.

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THE FORESTS OF ALASKA.

INTRODUCTION.

The ordinary resident of the United States has no conception of what Alaska really is. He has heard of the "Klondike" for the last fourteen years, and he wrongly thinks it is in Alaska. He has heard of great glaciers and high mountains, and that somewhere the thermometer occasionally registers 80° below zero. Beyond this his knowledge is likely to be even more fragmentary and unreliable. In reality, Alaska is of continental dimensions, and one can no more state briefly what its characteristics are than he can similarly describe those of the entire United States; yet a few words concerning its most salient features will not be amiss.

Alaska was purchased from Russia in 1867 for $7,200,000. The value of all its products since that date has been nearly $350,000,000. It has an area of 586,000 square miles, or 375,000,000 acres, or more than ten times that of the State of Illinois. From southeastern Alaska to the end of the Aleutian Islands is as far as from Savannah, Ga., to Los Angeles, Cal. Its northernmost and southernmost points are as widely separated as Canada and Mexico. Its range of temperature is greater than that between Florida and Maine.

More than one-third of this immense territory is yet but little explored, despite the many years that it has been in the possession of the United States, and despite the active efforts of prospectors, of traders, and of representatives of various branches of the National Government. The permanent population at the present time is estimated at some 40,000 whites and 25,000 natives; about half of the latter are Eskimo in the region adjacent to Bering Sea and the Arctic Ocean. The most important product is gold, of which the output in 1908 was valued at more than $19,000,000. Fisheries rank second, and the salmon packed in 1908 had a value in excess of $10,000,000.

Most of the internal improvements of Alaska have been made by the War Department. The telegraph system is constructed and operated by the Signal Corps, with offices at all important points. Transmission depends not only upon cable and land lines, but on high-power wireless stations as well. Roads are built chiefly by the Corps of Engineers of the War Department. Railroads, except for short

lines running out to a few mining camps, are utterly lacking, and the total railway mileage does not exceed 350. Transportation in summer is by steamboats on the larger streams and by poling boats on the smaller ones; in winter, by stages where the roads are good enough, and more generally by dog teams. Alaska has 4,000 miles of navigable rivers; without them most of the present development would have been impossible.

Alaska does not have even a territorial form of government, though during the past few years it has had a delegate in Congress. Called a territory by courtesy, its anomalous standing for years was that of a customs district. It has executive and judicial officers appointed by the President and the Senate, but no legislature; all legislation is by Congress.

Several sources of information have been used in the preparation of this report; a great deal of information has been obtained from the publications of the United States Geological Survey, and Greeley's Handbook of Alaska also has been helpful. Most of the material, however, was secured at first hand in the summer of 1909.

PHYSICAL FEATURES.

The United States Geological Survey recognizes four main divisions of the surface of Alaska. These are:

(1) The Pacific Mountain system, which, in southeastern Alaska, is a continuation of the mountains of British Columbia, extends northwest to the Mount McKinley range, and then swings sharply to the southwest, with a prolongation far into the Pacific Ocean, represented by the Aleutian Islands.

(2) The central plateau region, which includes most of the Yukon and Kuskokwim basins.

(3) The Rocky Mountain system, which bounds the central plateau region on the north and northeast.

(4) The Arctic slope to the northward of the Rocky Mountain system.

The Pacific Mountain region is characterized on the coast by innumerable fiords and inlets, by deep inland passages and mountains which rise thousands of feet almost straight up from tide water. In the interior it culminates in Mount McKinley, the highest point on the North American continent. There is very little level land in this region, especially in the southeastern part. The mountains are great masses of rock and the upper parts of them are covered with perpetual snow and ice. On the coast many glaciers reach tide water, but in the interior they are confined to higher altitudes.

The Central Plateau region is not so much a plateau as it is a rolling-hill and low-mountain country with wide stream valleys. Its area is nearly as great as that of the other three combined. The

raising of this region above an earlier level has resulted in stream-cutting, which obscures its original plateau character. It is in the extensive valleys and on the adjacent slopes of the Yukon, Tanana, and Kuskokwim rivers and their tributaries that the interior forests reach their best development.

The Rocky Mountain region is a comparatively narrow elongation of the Rocky Mountain system of North America, and stretches

FIG. 1.—Map of Alaska and adjacent regions. Aleutian Islands omitted.

across northern Alaska nearly from east to west. The mountains of this region reach a considerable though in no case a noteworthy height. On their southern slope head many streams which empty into the Yukon; those on the northern slope empty into the Arctic Ocean.

The Arctic slope region, lying north of the Rocky Mountain region, is composed of rolling tundras, in which truly Arctic conditions prevail. It has been less explored than any other portion of Alaska.

In many places in the interior the post-glacial silts and sands form an excellent soil, and upon them whatever future agriculture there may be in Alaska will chiefly be developed.

CLIMATE.

The climate of the southern and southeastern coast region of Alaska is mild and wet. The annual precipitation at Juneau and Sitka is from 80 to 90 inches. At these points the precipitation is chiefly in the form of rain, and only during a short time in the middle of the summer are there likely to be days when rain does not fall. In the mountains immediately above tide water, however, the snowfall is very great. This increases to the northward, and at Valdez a winter's snowfall of nearly 60 feet has been recorded. The lowest temperature on record at Sitka is 4° F. below zero, and the highest 87°. At Juneau the lowest record is 10° below zero, and the highest 88°. The Sitka temperature is but little cooler than that of the northern part of Puget Sound or of Scotland.

Sharply contrasted with the climate of southeastern and southern Alaska is that of the central plateau region of the interior. The Pacific Mountain system cuts off the warm, moisture-laden ocean winds so that the interior has a semiarid continental climate subject to sudden changes and great extremes. Satisfactory records are lacking, but such as are available indicate an annual precipitation in the Yukon Valley of about 15 inches, including melted snow. As low as 80° F. below zero has been registered in winter, and in the summer as high as 93°. The summers are short and comparatively hot; the winters long and intensely cold. The snowfall is light, but there is no thawing from the "freezeup" in the fall, generally in October, until the "breakup" in the latter part of April or early in May. Under these conditions, which have existed for ages, the ground has become permanently frozen to great depths. On the other hand, there are occasional areas on the hillsides and in the river valleys where the ground does not freeze more each winter than is thawed out during the summer. When the normal covering of moss is cleared from the deeply frozen ground, and the sun given a chance to get at it, a few years' cultivation results in its thawing out for several feet below the surface.

Despite the low temperatures and long winters of the Yukon Valley, there is ordinarily a good growing season of at least three months. During much of this time daylight is almost continual, and growth is rapid. This compensates in a marked degree for the shortness of the season; and since the evaporation is not great the vegetation is by no means of an arid character, notwithstanding the small

FIG. 1.—WESTERN HEMLOCK FOREST NEAR KETCHIKAN. TREES RANGE IN DIAMETER FROM 12 TO 24 INCHES, AND IN HEIGHT FROM 75 TO 100 FEET.

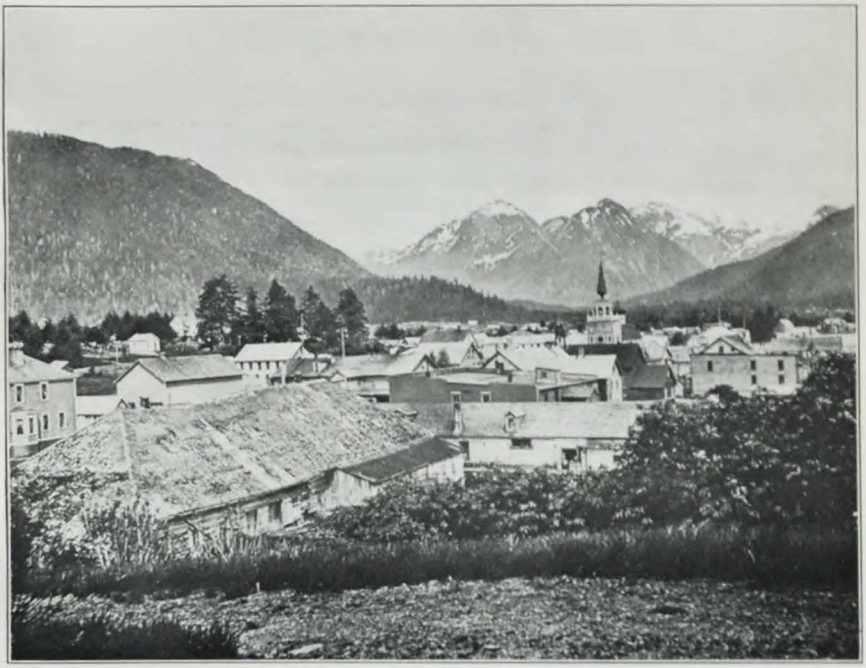

FIG. 2.—VIEW OF SITKA AND SURROUNDING FOREST COVERED SLOPES.

(Photograph by A. S. Hitchcock.)

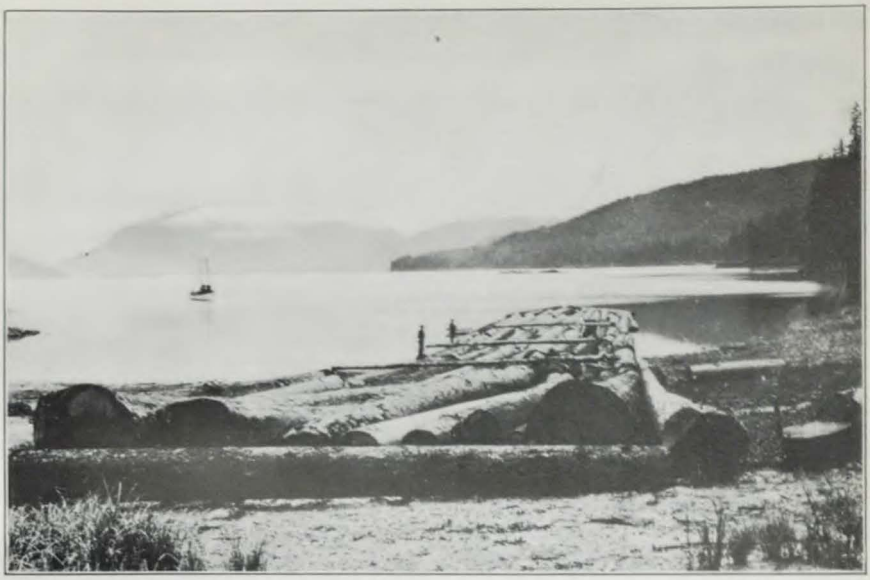

FIG. 1.—RAFT OF SITKA SPRUCE LOGS ON BEACH NEAR WRANGELL. AVERAGE DIAMETER AT THE BUTT 37 INCHES, AT THE TOP 21 INCHES. AVERAGE LENGTH, 78 FEET. CONTENTS OF RAFT APPROXIMATELY 190,000 BOARD FEET, SCRIBNER SCALE.

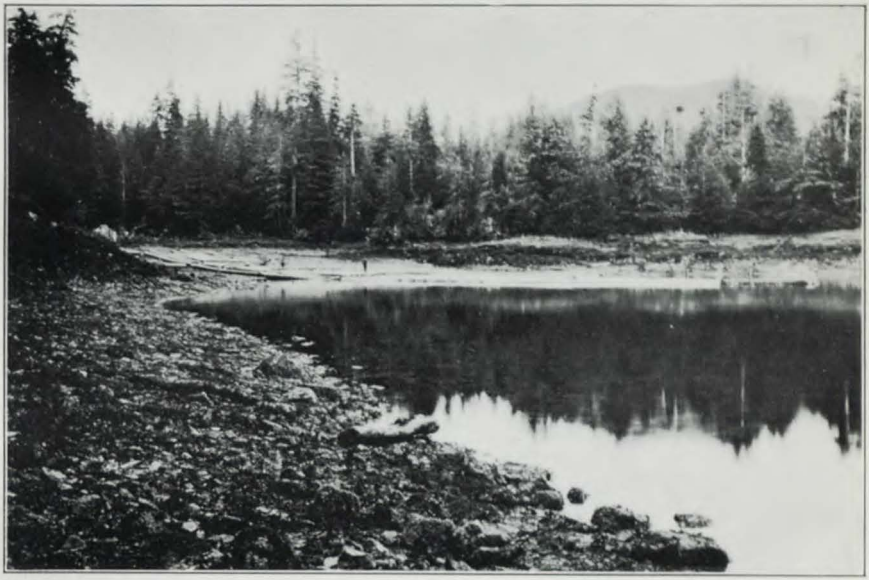

FIG. 2.—RAFT OF SITKA SPRUCE LOGS SHOWN IN FIGURE 1, WITH GENERAL VIEW OF SHORE FOREST AFTER CUTTING OF RAFT. STANDING TIMBER CONSISTS OF SITKA SPRUCE, WESTERN RED CEDAR, AND WESTERN HEMLOCK.

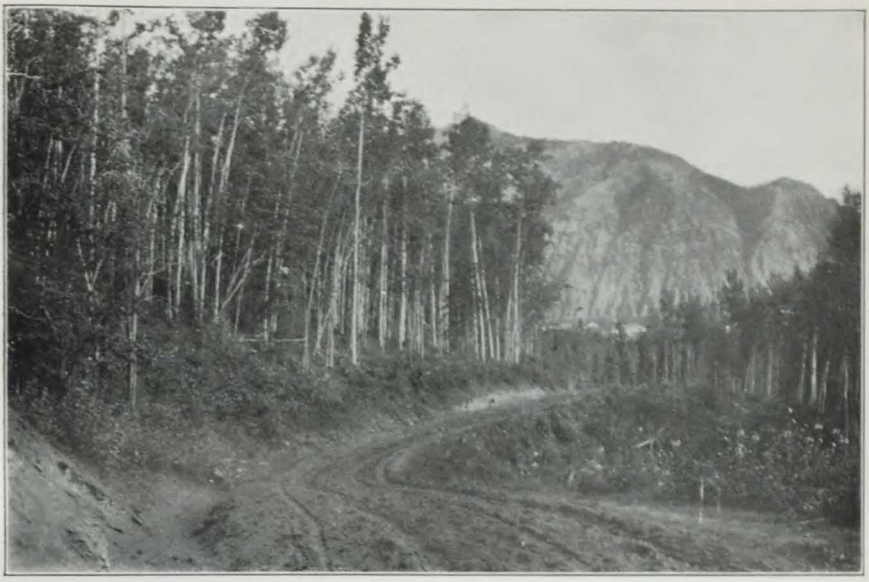

FIG. 1.—MIXED WHITE BIRCH AND ASPEN FOREST ON SANDY SLOPE SOUTH OF EAGLE. TIMBER 2 TO 6 INCHES IN DIAMETER, 20 TO 35 FEET IN HEIGHT. BUILDINGS AT FORT EGBERT, AND EAGLE MOUNTAIN IN THE BACKGROUND.

FIG. 2.—TYPICAL FOREST ON THE YUKON FLATS ABOUT 20 MILES BELOW FORT YUKON ON THE ARCTIC CIRCLE. TIMBER CHIEFLY WHITE SPRUCE, 2 TO 8 INCHES IN DIAMETER AND UP TO 50 FEET IN HEIGHT; SOME BALSAM POPLAR AND LARGE WILLOW.

precipitation. The frozen subsoil is practically impervious to water, which accumulates in poorly drained areas and causes the many swamps and "muskegs."

FOREST TYPES.

The differentiations between forest types are as sharp as those between the topographic and climatic, and, of course, depend upon them. The coast forests of southern Alaska are the northernmost extension of the coast type of Washington and British Columbia. The interior forests are an extension of the interior Canadian forests. The forests of the Susitna and Copper river basins are somewhat intermediate in character, since these rivers rise in the interior and break through the mountain barrier to the southern coast.

On the coast of southeastern Alaska trees grow to large size; in the interior the timber is much smaller. The higher mountain areas are completely above timber line. Climatic conditions in the region adjacent to Bering Sea and on the Arctic slope make forest growth altogether impossible, so there are great stretches of tundra whose vegetation consists chiefly of moss, sedges, and a few small shrubs. Moss may be said to be the garment of Alaska, and layers of it 12 to 18 inches thick are not at all uncommon either on the coast or in the interior.

Plate I (frontispiece), from Professional Paper No. 45, United States Geological Survey, shows roughly the forest distribution in Alaska. With this map as a basis and making reductions for some barren areas which it includes as forested, it is estimated that the total forest and woodland area of Alaska is approximately 100 million acres, or about 27 per cent of the land surface of the territory. Of these, about 20 million acres may possibly bear timber of sufficient size and density to be considered forest in the sense that much of it can be used for saw timber, while the balance, or 80 million acres, is woodland which bears some saw timber, but on which the forest is of a smaller and more scattered character and valuable chiefly for fuel.

There is not sufficient information upon which to base any satisfactory estimate of the total stand of timber in Alaska. It has been estimated, for instance, that the coast forests contain 75 billion feet of merchantable saw timber, but this estimate might be much exceeded were both the spruce and hemlock closely utilized. More than twenty cords per acre have been cut in good stands of birch and aspen in the interior, but, on the other hand, there are large areas of black spruce that is too small to use for any purpose; so that it is still impossible to give a satisfactory estimate of the total stand.

THE COAST FORESTS.

The coast forests of southeastern and southern Alaska are nearly all included in the Tongass and Chugach National Forests, which com-

prise 26,761,626 acres; and a large proportion of this area is forested. The species are chiefly western hemlock (*Tsuga heterophylla*), Sitka spruce (*Picea sitchensis*), western red cedar (*Thuja plicata*), and yellow cedar (*Chamæcyparis nootkatensis*), with occasional specimens of lodgepole, or shore, pine (*Pinus contorta*), black hemlock (*Tsuga mertensiana*), Alpine fir (*Abies lasiocarpa*), black and white spruce (*Picea mariana* and *Picea canadensis*), balm of Gilead, locally known as balsam poplar (*Populus balsamifera*), black cottonwood (*Populus trichocarpa*), Oregon alder (*Alnus oregona*), and several birches and willows. Sitka spruce and hemlock grow almost everywhere in this region, though in Kenai Peninsula the spruce extends farther westward than the hemlock and grows also on Kodiak Island. The cedars grow in commercial quantities only in the extreme southeastern part, though yellow cedar is occasionally found in the Chugach Forest. Lodgepole pine grows as far north as Skagway, but is of no commercial importance.

On the coast the timber line is low. On Deer Mountain at Ketchikan, for instance, spruce saw timber stops at about 1,500 feet, and the peak, with an elevation of 3,000 feet, bears only stunted black hemlock.

GROWTH AND STAND.

In the coast region the stand is generally dense, and as much as 25,000 feet per acre has been estimated for considerable tracts. Sitka spruce probably averages 20 per cent of the stand, and western hemlock about 75 per cent. The spruce reaches a large size, and occasionally attains diameters of more than 6 feet and heights of 150 feet. Diameters of 3 to 4 feet are attained by western red cedar. While by far the most abundant species, western hemlock does not produce as large individual trees as the spruce or the cedar. (Pl. II, fig. 1.) The heavy rainfall causes an undergrowth of moss and brush which completely covers the surface except where it is too rocky or too steep. So dense is this surface covering that one may walk long distances without touching bare soil. Water exudes from the moss when it is stepped upon, as from a sponge, and consequently there is little or no damage by fire in the coast forests.

Practically the entire forest of the coast region is overmature. It has been accumulating for ages uninjured by fire or cutting. Shallow, rocky soil, steep mountain slopes, or poor drainage often prevent thrifty growth, and on such sites "stagheadedness" and decay are common. In favorable situations the rate of growth of the coast trees is fairly rapid. The following examples are typical:

A western red-cedar stump in good soil on the south slope of a gorge above Ketchikan showed 235 rings. The diameter of this stump outside the bark was 38 inches. A 40-inch Sitka spruce stump in the same locality had 230 rings. This tree had been 125 feet high.

Near Wrangell three Sitka spruce logs averaged 32 inches in diameter at the butt inside the bark, with 262 annual rings. Two examples of extreme age in Sitka spruce were noted in Portage Bay between Petersburg and Juneau. A section of a log 54 inches in diameter taken 25 feet above the ground had 600 rings; another log 54 inches in diameter 8 feet above the ground had 525 rings. Both were entirely sound.

LOGGING.

Logging in southeastern Alaska employs the crudest of methods. It is now carried on entirely by hand, though logging machinery was used in a few earlier operations. Only the best spruce trees at the edge of tide water are cut. The logs are frequently made the entire length of the tree, and are jacked up and rolled into the water, where they are tied into rafts and towed to the sawmill by tugs. It is a common thing, for instance, for a man to buy 100,000 feet of stumpage from a National Forest, and with two companions to work at it a couple of months or so until it is all rafted. The sawmill owner usually advances the stumpage price, $1 per thousand, to the cutters, and in addition pays them from $3.75 to $4.50 per thousand for the logs in the raft. The operator tows the raft to the mill and there cuts the logs into suitable lengths. Under these circumstances the men who buy stumpage make little but wages. A typical raft of this character is shown in Plate III, figure 1. This raft was cut 16 miles from Wrangell, on the shore of the Eastern Passage, about 4 miles from Sawmill Creek.

The logs in this raft were peeled, and represented approximately the used length of the trees. They averaged 78 feet long, 37 inches in diameter at the butt, inside the bark, and 21 inches in diameter inside the bark at the top.

UTILIZATION.

The annual lumber cut in the coast forests of Alaska is about 27,000,000 board feet. This consists almost entirely of spruce, since hemlock is but little used. There are about 25 sawmills on the coast, at Cordova, Douglas, Juneau, Katalla, Ketchikan, Petersburg, Seward, Sitka, Valdez, Wrangell, and other points, most of them rather crude in character and of small capacity. A large proportion of the output, probably more than one-third, is used for salmon cases, and much of the best lumber goes into them. They are usually made to hold 48 1-pound cans. The ends of the cases or boxes are of ¾-inch stuff, and the tops, bottoms, and sides of ⅜-inch material. It is commonly figured that to make a box requires 5 or 6 feet of lumber. The usual price received at the sawmills for salmon cases is about 10 cents each, equivalent to about $20 per thousand

for the lumber which they contain. The annual pack of salmon is about 2,000,000 cases. The bulk of the boxes required is supplied by the local mills.

FUTURE SUPPLY.

The southern and southeastern coast of Alaska has a much greater timber supply than there is any reason to think will be needed locally for a long time to come. The permanent industries of the region are fishing and mining. The mountainous character of the country will forever prevent agricultural operations of any magnitude. The total stumpage is large, much of it overmature, and the proportion of hemlock too great. The timber should be cut and utilized as soon as possible and the spruce, which is more valuable than the hemlock, should be given an opportunity to increase. Under present conditions, with the well-known ability of the hemlock to reproduce under shade and upon decaying logs and débris, it has the advantage of the spruce.

Since the Alaska coast forests do not contain timber of either as high quality or as great variety as grows in Oregon and Washington, there is little likelihood that lumber from them will compete largely in the general market with lumber from those States. In fact, some lumber used in southeastern Alaska is imported from the Pacific Coast States, but good management on the part of the Alaska mills should enable them to supply the home demand for common kinds of lumber. While Alaska may eventually export considerable material of this sort, it must continue to import timber like Douglas fir for heavy construction work. Utilization for other purposes than for lumber should be encouraged. The most promising of these is for pulp. Both the spruce and hemlock are undoubtedly good pulp woods, and, taken together, they comprise almost the entire forest.

There is a supply of water, without storage, for six or eight months of the year, for the needs of pulp mills, and transportation to the States through the inside passage to Seattle would be quick and cheap. The country is mountainous, it is true, and logging appears difficult, but much of it would be no more difficult than that of the Pacific coast, and modern ingenuity can safely be relied upon to get most of the timber out as soon as there is a market for it.

The cutting which has so far taken place on the coast of Alaska has had small effect upon the forest. The bulk of it is yet untouched, as is strikingly brought out in Plate III, figure 2, which shows the forest from which a raft of spruce logs was recently cut. Clearly, utilization should be encouraged as much as possible. With respect to the coast forests, there is little in the statement sometimes made, that the timber in Alaska should be held for the sole use of Alaskans. It should be manufactured into the most suitable forms and sold

FIG. 1.—VIEW ACROSS YUKON VALLEY TO TOWN OF RAMPART AND HILLS BEYOND, FROM U. S. AGRICULTURAL EXPERIMENT STATION. TIMBER MOSTLY CLEARED AND CUT. BLACK SPRUCE AT THE EDGE OF RIVER, WITH OCCASIONAL VETERAN WHITE SPRUCE.

FIG. 2.—FISH AND WOOD CAMP ON THE TANANA RIVER NEAR TOLOVANA. WHITE SPRUCE AND WHITE BIRCH CORD WOOD FOR RIVER STEAMERS HAS BEEN CUT FROM THIS FOREST; BALSAM POPLAR AND ASPEN LEFT STANDING. FISH WHEEL FOR CATCHING SALMON AT THE RIGHT.

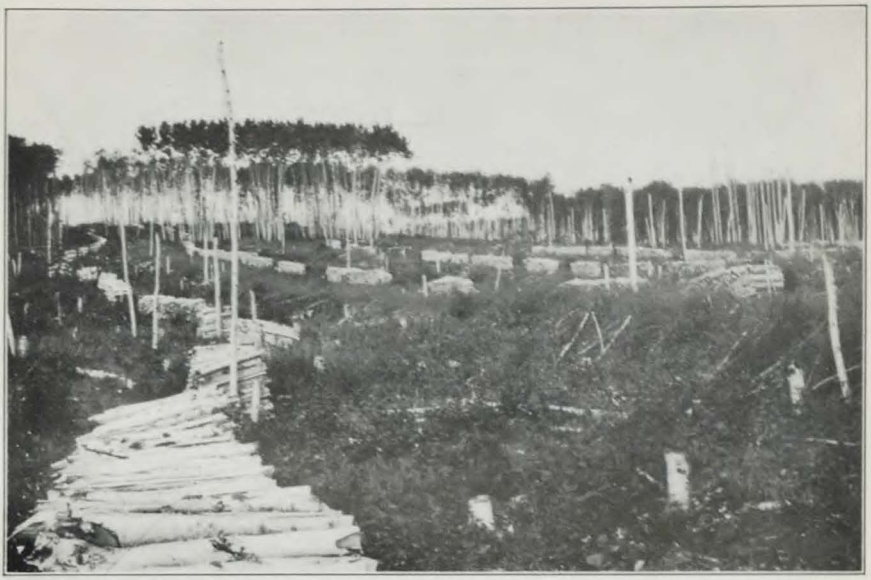

FIG. 1.—CORD WOOD CUTTING IN WHITE BIRCH FOREST NEAR FAIRBANKS. CLUMP OF UNCUT ASPEN IN THE BACKGROUND.

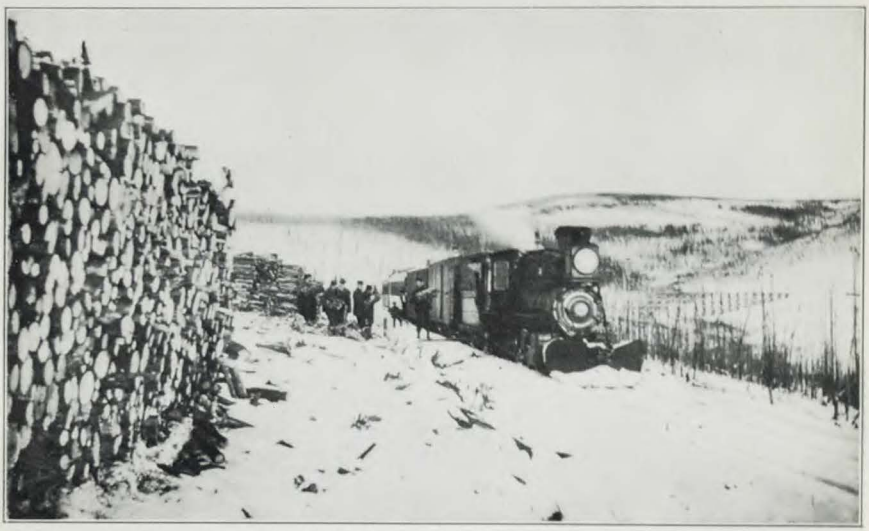

FIG. 2.—"WOODING UP" THE ENGINE ON THE TANANA VALLEY RAILROAD NEAR FAIRBANKS. REMNANT OF ORIGINAL FOREST, MOSTLY FIRE-KILLED.

(Photograph by Johnson.)

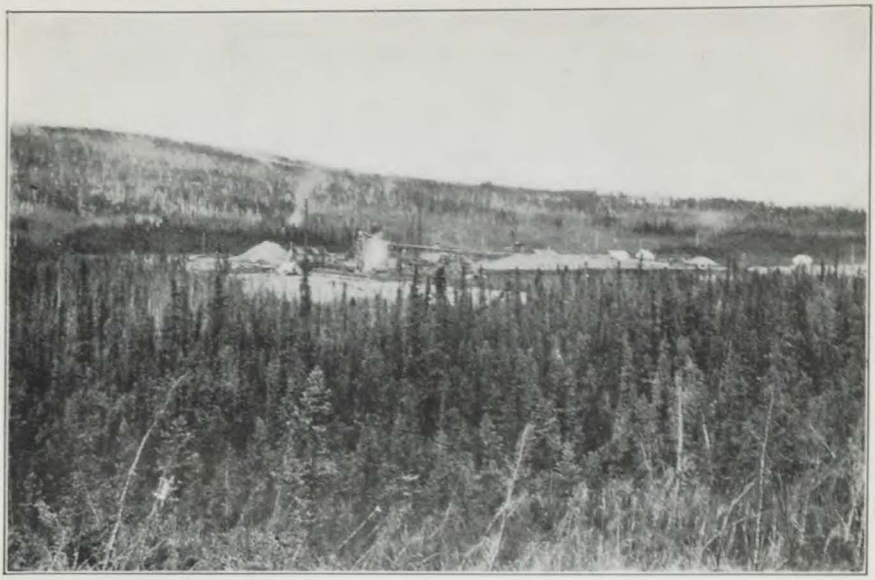

FIG. 1.—TYPICAL MINING OPERATION ON ENGINEER CREEK NEAR FAIRBANKS. SMALL BLACK SPRUCE IN THE FOREGROUND; PARTIALLY FIRE-KILLED BIRCH AND ASPEN ON SLOPE IN THE BACKGROUND.

FIG. 2.—TYPICAL FLUME AND SLUICE BOXES USED IN PLACER MINING FOR GOLD IN THE FAIRBANKS DISTRICT. MUCH LUMBER AND MANY POLES ARE REQUIRED FOR THESE PURPOSES.

(Photograph by Johnson.)

wherever it best can be marketed. Natural barriers, so far unsurmounted, prevent it from being of benefit to the interior, where the need is greatest and the price highest. Moreover, the coast forests are not capable of producing a great deal of the structural material that will be needed in the interior when the latter region is more fully developed and made accessible by railroads.

The annual growth of the coast forests is far in excess of the local needs, and unless methods of utilization are developed which will result in the export of forest products these forests can not be handled rightly.

THE INTERIOR FORESTS.

The forests of interior Alaska are practically all included within the drainage basins of the Yukon and Kuskokwim rivers. They are chiefly of the woodland type, and are estimated to cover approximately 80 million acres, but probably not more than 40 million acres bear timber of sufficient size and density to make it especially valuable for either cord wood or saw logs. The tree species include white spruce (*Picea canadensis*), white birch (*Betula alaskana*), balsam poplar (*Populus balsamifera*), black cottonwood (*Populus trichocarpa*), aspen (*Populus tremuloides*), black spruce (*Picea mariana*), and tamarack (*Larix alaskensis*). Of these the white spruce is the most important, since it furnishes the only saw timber of the region and is also much used for fuel. White birch is extremely abundant, as are also poplar and aspen, in many localities. Black spruce is of general occurrence and abundant. Mixed forests of all species are common, though there are occasional pure stands of each species.

The best timber of spruce, birch, and poplar grows in the valleys of the streams, particularly along the Tanana, and excellent stands of birch and aspen are found also on the easterly and southerly slopes of creeks which have a silt soil. This is particularly true in the Fairbanks district. Black spruce predominates in the more poorly drained situations. Here, as farther south, it is characteristically a swamp and muskeg tree, though in some places abundant on hill and mountain slopes. Tamarack grows sparsely in river and creek valleys, but is nowhere of particular importance.

GROWTH AND STAND.

The stand in the interior forests varies from practically nothing in areas of scrubby black spruce to 20 or more cords per acre in the birch-aspen type, and several thousand board feet per acre in the best white-spruce forest. The average of the timber is small throughout; white spruce rarely and balsam poplar sometimes attain diameters of from 18 to 24 inches. The average diameter in white birch and aspen stands is about 8 inches, though maximums of 18 inches on unusually favorable sites were noted for these species. Black

spruce rarely attains a diameter of 6 inches, and the less abundant tamarack is even smaller. The best white-spruce trees are about 75 feet high. Birch, aspen, and poplar usually reach a height of about 50 feet; black spruce rarely more than 40 feet, many times not exceeding 20 feet, and tamarack seldom more than 30 feet. Naturally, it is impossible for timber to grow rapidly or to large sizes in soil which is perpetually frozen. On such sites the roots can penetrate only the overlying cover of moss and humus and must spread out flat upon the frozen layer beneath. Rapid and thrifty growth has taken place only upon warm slopes and in river valleys with sandy soil, where the roots are able to go deeper.

The following detailed notes upon the rate of growth of white spruce and white birch were secured. It was very difficult to count the rings on white birch, and in some cases it was practically impossible to calculate them closer than to the nearest ten. Ring counts on white-spruce stumps, which had grown under favorable conditions on Minook Creek above Rampart, are given in Table 1.

TABLE 1.—*Diameter growth of white spruce, as shown by ring counts on stumps, with averages.*

Height.	Diameter outside bark.	Rings.	Height.	Diameter outside bark.	Rings.	Height.	Diameter outside bark.	Rings.
Inches.	*Inches.*	*Number.*	*Inches.*	*Inches.*	*Number.*	*Inches.*	*Inches.*	*Number.*
24	12.5	125	20	7.5	170	16	12.5	140
22	7.5	150	12	6.0	170	16	12.5	140
.....	11.0	140	12	11.5	140			
24	8.0	140	24	14.0	140	19	10.3	146

Table 2 gives similar information on white spruce. The measurements were made on logs at a Fairbanks mill.

TABLE 2.—*Diameter and height growth of white spruce, as shown by ring counts on saw logs, with averages.*

Butt.		Length.	Top.		Butt.		Length.	Top.	
Diameter outside bark.	Rings.		Diameter outside bark.	Rings.	Diameter outside bark.	Rings.		Diameter outside bark.	Rings.
Inches.	*Number.*	*Feet.*	*Inches.*	*Number.*	*Inches.*	*Number.*	*Feet.*	*Inches.*	*Number.*
17.0	167	37.2	11.0	108	17.0	198	33.7	11.9	130
16.4	155	33.3	11.3	110	18.4	168	32.6	11.5	114
15.6	110	35.1	11.0	70	16.1	146	33.0	11.0	120
17.3	150	25.0	13.2	100	15.4	150	32.7	11.1	110
18.8	198	35.7	12.0	130	14.8	110	32.5	10.3	88
16.0	136	33.1	11.2	110	17.0	124	28.3	11.0	85
16.1	118	30.5	12.1	93	16.0	90	30.6	12.2	78
15.0	140	32.9	11.2	100	17.2	120	33.0	11.1	80
14.7	100	30.5	11.6	75	15.8	117	32.8	11.1	80
15.4	200	32.8	10.5	160	15.7	97	31.7	10.2	68
19.0	116	32.7	10.6	80	16.0	155	33.0	11.5	125
17.0	190	35.3	11.3	160					
16.2	200	35.7	11.8	137	16.4	143	32.6	11.3	104
15.5	120	30.7	11.3	83					

These logs were cut on Chena River, about 75 miles above Fairbanks, and were above the average in quality. They were cut under a special contract of $5 per thousand extra for long logs, and probably represented the used lengths of the trees. The measurements show an average diameter growth at the butt of 1 inch in eight and seven-tenths years, and an average height growth of 10 inches yearly, which compares favorably with the rate of growth of red spruce in New York and New England. The most rapid diameter growth noted on any of these logs for a period of ten years was 2½ inches, and the slowest growth for the same period 0.4 of an inch. The butts averaged about 2 feet above the ground. The butt swell was avoided in measuring the logs, so that these figures should be safe for use in determining taper and volume. The bark averaged 0.15 to 0.20 of an inch in thickness.

Ring counts on white spruce stumps on the southerly and easterly slopes on the west side of upper Isabelle Creek, northeast of Fairbanks, are given in Table 3.

TABLE 3.—*Diameter growth of white spruce as shown by ring counts on stumps, with averages.*

Height.	Diameter outside bark.	Rings.	Height.	Diameter outside bark.	Rings.	Height.	Diameter outside bark.	Rings.
Inches.	*Inches.*	*Number.*	*Inches.*	*Inches.*	*Number.*	*Inches.*	*Inches.*	*Number.*
25	21.50	125	22	17.00	125	34	17.00	125
22	16.50	110	31	18.00	120	30	17.50	120
29	21.50	120	35	16.00	115	22	15.00	95
19	14.50	133	26	19.25	120	28	24.00	126
24	18.75	130	30	19.50	125			
27	16.50	130	28	22.50	120	27	18.44	121

These stumps were on a warm, sandy loam soil in a mixed forest of white birch, white spruce, and aspen. They represent the best development of white spruce timber in the Fairbanks region under the most favorable conditions. The average diameter increase was 1 inch in 6.6 years.

About 1 mile north of this place the following counts were made on birch cord wood which had grown under the same conditions as the white spruce. Counts were made on cord wood because it was impossible to distinguish the rings on the birch stumps.

TABLE 4.—*Diameter growth of white birch as shown by ring counts on cord wood, with averages.*

Diameter outside bark.	Rings.	Diameter outside bark.	Rings.	Diameter outside bark.	Rings.
Inches.	*Number.*	*Inches.*	*Number.*	*Inches.*	*Number.*
5.0	60	6.5	80	9.0	85
10.0	115	7.0	70	10.0	95
8.0	90	7.5	75	10.0	95
8.0	110	5.5	75		
5.5	75	9.0	115	7.9	89
10.0	100	7.5	90		

Considering the short growing season, these figures show a very satisfactory rate of growth for white birch, 1 inch in diameter in 11.3 years, and under the same conditions an exceedingly rapid growth for white spruce.

Table 5 was made from measurements on white birch 4-foot cord wood in the yard of the Northern Commercial Company at Fairbanks.

TABLE 5.—*Diameter growth of white birch as shown by ring counts on cord wood, with averages.*

Diameter outside bark.	Rings.	Diameter outside bark.	Rings.	Diameter outside bark.	Rings.	Diameter outside bark.	Rings.
Inches.	*Number.*	*Inches.*	*Number.*	*Inches.*	*Number.*	*Inches.*	*Number.*
4.75	70	4.50	60	5.00	70	6.50	70
7.00	60	4.25	60	6.50	70	5.50	100
4.25	50	5.50	100	7.00	80	4.25	70
5.00	60	7.50	90	8.00	90	5.50	60
6.00	70	5.75	90	5.50	60		
7.00	80	6.25	70	5.00	70	5.84	73
4.00	60	6.50	65	9.00	95		

The rings were very difficult to count and in only a few cases was it possible to count them closer than to the nearest ten. Many sticks were examined and it is thought the figures given are a fair average for white birch in the vicinity of Fairbanks. This gives 12.5 years per inch of diameter.

UTILIZATION.

The bulk of the timber cut from the interior forests is for firewood. Most of it is handled without machinery. It is cut by ax into 4-foot lengths and piled by hand in long ricks. Yet, on the other hand, much of the firewood burned in Fairbanks is floated down the river in the log, and subsequently cut up into stove sizes by a small circular saw attached to a sled or 1-horse wagon and operated by a gasoline engine. Horses are used in banking logs for the sawmills, and the other mill operations are carried on in the usual manner. The logs for the Fairbanks mills are driven 75 to 150 miles from the

FIG. 1.—COMPLETE DESTRUCTION OF FOREST BY CUTTING AND FIRE NEAR FAIRBANKS. TIMBER OF TYPE SHOWN IN PLATE VII, FIGURE 1.

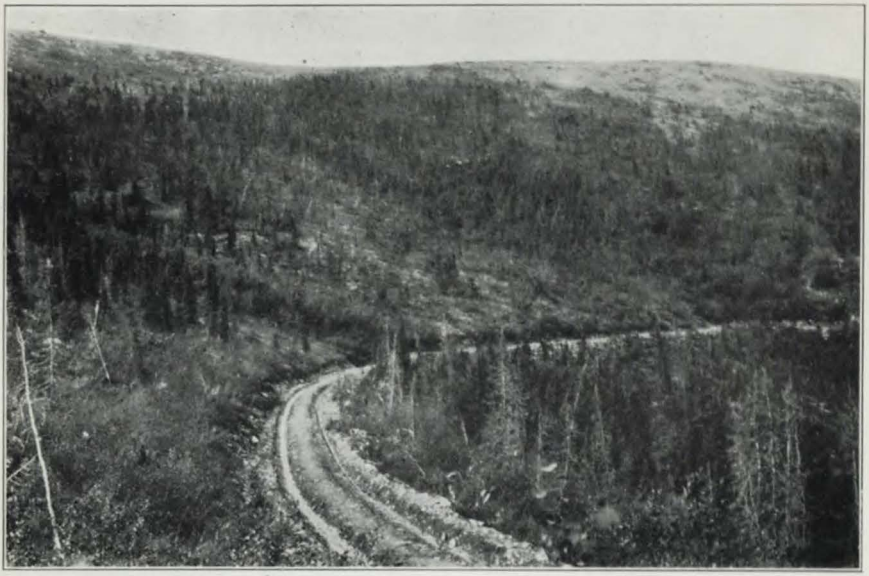

FIG. 2.—UPPER LIMIT OF FOREST ON NORTH SLOPE AT THE HEAD OF CLEARY CREEK. SMALL BLACK SPRUCE WITH A MAXIMUM HEIGHT OF 20 FEET. ELEVATION 2,300 FEET.

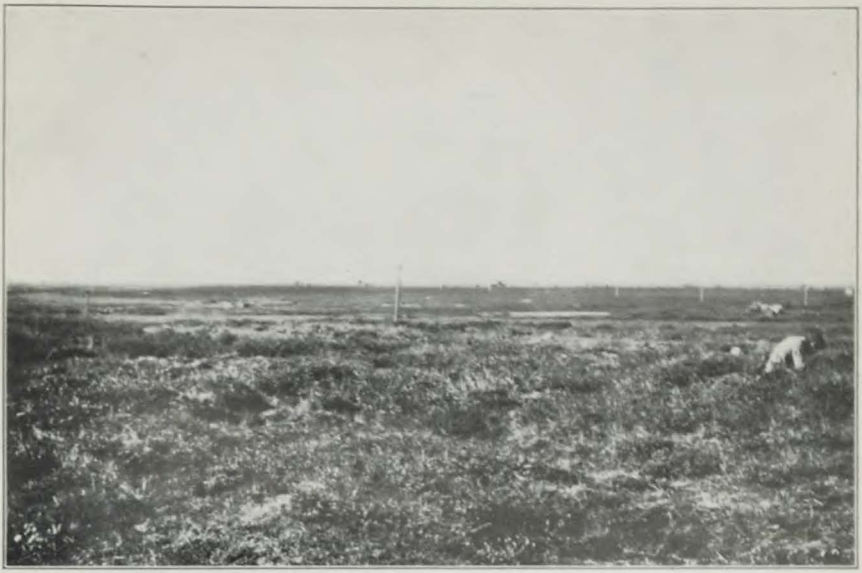

FIG. 1.—VIEW OF TYPICAL TUNDRA NEAR NOME. ONLY WOODY VEGETATION CONSISTS OF LOW SHRUBS OF WILLOW, BLUEBERRY, AND BIRCH.

FIG. 2.—VIEW ACROSS NOME HILLS FROM TOP OF KING MOUNTAIN. ELEVATION OF HILL IN THE BACKGROUND, 1,700 FEET. VEGETATION OF THE TUNDRA TYPE.

Chena and Salchaket rivers. The Fairbanks mills pay $20 per thousand feet for ordinary white spruce logs, delivered at the mills, and $25 per thousand for extra long logs for special purposes. It takes about twelve 16-foot logs on an average to make a thousand board feet. The usual stumpage charge by the Land Office for timber cut from public lands is $1 per thousand board feet for saw timber, and 25 cents per cord for firewood.

Three sawmills are now in operation at Fairbanks and one at Chena, 9 miles distant. Two of the mills at Fairbanks have a daily capacity of about 20,000 board feet each, while the third is smaller. One of the mills is equipped to make all the usual styles of finishing material, and carries a stock of about 1½ million feet. The lumber is very knotty, and the most of it would be considered of the box grade in the States. About 10 to 20 per cent of it is surfaced. Common lumber brings about $35 per thousand at Fairbanks; boat lumber, which is of extra length and must be entirely sound, $80 a thousand.

There are small sawmills at Rampart, Council, and along the Copper and Susitna rivers, and also mills operated by the War Department at Fort Egbert (Eagle) and Fort Gibbon. Altogether the present annual cut of lumber by the interior sawmills probably does not exceed 4 million feet. The chief uses of the lumber are for flumes and sluice boxes, boat building, and to some extent for dwellings and business buildings in the towns. Most of the residences are log cabins.

Several times as much timber is used each year in the interior of Alaska for fuel as is used for lumber. The interior of Alaska depends entirely upon wood for heat, light, and power. The annual requirements in the town of Fairbanks, the only large camp in the interior, and on the adjacent creeks where mining is in progress, are probably about 60,000 cords. Fairbanks alone, with a population of about 3,000, uses 15 or 20 thousand cords of wood a year. Wood is burned by the Tanana Valley Railroad, which has 45 miles of track out from Fairbanks, and on river steamers, with the exception of three large boats on the Yukon, which burn oil. Wood is sold by the dealers in Fairbanks at from $9 to $10 a cord, with an added charge of $2.50 for cutting to stove lengths. Slab wood can be purchased for $2 a cord at the sawmills, but for heating in the winter it is not as satisfactory as round wood. The river steamers pay $6 to $8 per cord for 4-foot wood, ricked up on the bank. Wood choppers are paid $3.50 to $4 per cord. Both spruce and birch are used, though birch is preferred. Poplar and aspen are generally left uncut. Aside from this the wood choppers make clean cuttings and utilize the timber closely, often taking the limbs and tops down

to 3 inches in diameter, cutting the stumps close to the ground, and piling the brush well to get it out of the way of the haulers.

FIRES.

Unlike the coast forests of Alaska, the interior forests have suffered much from fire. Except on limited areas the cutting which has so far taken place in the interior is not serious, but the fire damage has been great. It probably would not be far from the truth to say that in the Fairbanks district ten times as much timber has been killed by fire as has been cut for either fuel or lumber. Fire follows the prospector and the settler, and everywhere that a mining camp develops under present conditions it is to be expected that fire will kill much of the timber. There are several causes for this. Miners and hunters are careless. Camp fires are neither properly guarded nor extinguished. A fire gets out and no one pays any attention to it unless it threatens his camp. Fires, too, may be set to clear off the ground so that prospecting is easier. Fires have been purposely set to secure dry timber, and the slashings along the telegraph lines have been another source of danger. Smudges are built to keep away the mosquitoes; in fact it is commonly said by the residents that mosquitoes cause more fires than any other one thing. The rainfall is light during the summer, and it does not take a long period of drought to make the forest burn rapidly. In the Klondike region, and on the upper Yukon, in Canada, fires have done even much more damage than in Alaska. During the entire trip of 460 miles down the river from Whitehorse to Dawson, one is almost constantly in sight of fire-killed forests. Much fire-killed timber is also seen along the Yukon in Alaska from Eagle to the mouth of the Tanana, but from that point to the beginning of the tundra the forest, though small, is, for the most part, as yet undamaged by fire.

The danger season is short, with extreme limits approximately from May 15 to September 15. During 1909 there was a bad fire near Fairbanks early in the season, but none during July or August. On the other hand, there were fires along the Yukon in both the latter months. No measures but the posting of notices are taken to prevent forest fires in the interior of Alaska, and little is done to control them, except as they immediately threaten someone's property.

THE FUTURE OF ALASKA FORESTS.

THE COMING DEMAND FOR TIMBER.

Alaska has a permanent future. For the southern and southeastern coast its chief potentialities lie in fishing and in lode mining of gold and copper; for the interior there is the mining of gold, copper, and coal, and in certain localities there are opportunities for agriculture. Fairbanks and Nome have passed their palmiest days as placer camps.

With crude equipment and high-priced labor, the placer miner can work only the richest ground. His time is soon over. The low-grade ground, which is always the most extensive, can be worked profitably only by large capital and the most economical methods. This stage has already been reached in the Klondike. It is coming in Alaska. This will mean long-time operations. Then, too, there is the probable development of lode mining for gold, which also requires large investments and long-time operations. There are agricultural possibilities in the Tanana and some other valleys. Nearly every cabin in Fairbanks has a fine vegetable garden. Large quantities of potatoes are already raised, and occasional fields of oats and barley. The Government has experiment stations at Rampart and Fairbanks, which are growing both grain and vegetables. Agriculture in the interior of Alaska should eventually be sufficient to supply at least the local needs for vegetables, and for horse and cattle feed. Enthusiasts predict a large population for the Tanana Valley within the next twenty-five years. Transportation at present is slow, expensive, and uncertain by means of river boats, which operate only a few months of the year. The building of one or more trunk lines of railway would greatly accelerate the development of the country.

These resources already hold great promise, and doubtless there are others which can not now be anticipated.

The present sparse population will undoubtedly be greatly augmented before many years. Alaska is almost a continent by itself, and so far removed from the rest of the United States that it should eventually depend as much as possible upon its own resources. This makes it particularly necessary that the timber should be conserved. The present population is made up largely of miners and others whose only purpose is to make a stake and leave as quickly as possible thereafter. They are only too willing to skin the country for their own benefit, without thought for the future. This will change as soon as people go to Alaska expecting to make their homes there for at least a considerable period of years, and there are already some families of this sort in the Tanana Valley.

WHAT SHOULD BE DONE.

Obviously all the forests of Alaska, whether on the coast or in the interior, should be protected and made of the utmost permanent use. The coast forests, which include most of the saw timber of the Territory, and by far the heaviest stands, are nearly all protected by National Forests. They have not been damaged by fire, and are but slightly reduced by cutting. They are overmature. Carefully planned cutting should take place as soon as possible. Every effort should be made to have them utilized for lumber, and especially for pulp. They should be so managed as to increase the stand of spruce

and decrease that of hemlock. In the interior forests, situated entirely upon public lands, unregulated cutting and devastating fires are going on. The coast forests were reserved before they were impaired. Those of the interior have already been seriously damaged. Their protection can not begin too soon. While the products of the coast forests need a foreign market, the interior forests with the best of treatment are not likely to supply more than a part of the home demand. If protected they will continue to furnish logs for cabins, low-grade lumber, and fuel indefinitely. Higher grade lumber required by the interior must always be imported.

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